AIR BORN INFECTION

Bordetella pertussis

(WHOOPING COUGH, PERTUSSIS)

The genus *Bordetella*, has several species, includes the species *B. pertussis*, *B. parapertussis, and B. bronchiseptica*. Of the three, the pathogen responsible for whooping cough, B. pertussis, is of greatest concern for humans. The other two species are occasionally observed as human pathogens in lower respiratory tract infections.

Morphology and culture:

1. *B. pertussis* bacteria are small, coccoid, nonmotile, Gram-negative rods.
2. Can be grown aerobically on special culture mediums at 37 8C for three to four days.
3. Encapsulated.

Transmission & Epidemiology.

Pertussis bacteria are transmitted by aerosol droplets

Pathogenicity Factors of Bordetella pertussis

- **Adhesion factors.**
  The two most important factors are filamentous hemagglutin (FHA) and pertussis toxin (Ptx:). The latter can function both as an exotoxin and as an adhesin. The pathogenic cells attach themselves to the epithelial cilia. . They are able to attach themselves to the cells of the ciliated epithelium in the bronchi. They rarely invade the epithelium. The infection results in (sub-) epithelial inflammations and necroses.
- **Exotoxins.**
  Pertussis toxin: AB toxin (ADP-ribosyl transferase. Inactivation of ribosomal elongation factor eEF2 resulting from ADP-ribosylation during protein synthesis; leads to cell death); the A component is an ADP-ribosyl transferase; mechanism of action via Gs proteins (as with cholera toxin A1, this resulting in edema and other changes in respiratory tract leading to cough); increased amount of cAMP in target cells, with a variety of effects depending on the type of cell affected by the

toxin. Invasive adenylate cyclase: AB toxin; A enters cells, acts in addition to pertussis toxin to increase levels of cAMP.

- **Endotoxins.**

Tracheal cytotoxin: murein fragment; kills ciliated epithelial cells.

1. Lipopolysaccharide: stimulates cytokine production; activates complement by the alternative pathway.
2. Ptx: consist of A & B chain; **A chain** consist of 1 subunit S_1, while **B chain** consist of 5 subunits 5S;$S_{2,3,4,4,5}$)

Clinical disease of *Bordetella pertussis*

- Is localized only in the respiratory tract and is highly contagious.
- Is associated with a variety of symptoms; generally, the younger the patient, the more severe the disease.
- Is associated with the following prognosis: one third of unvaccinated patients recover without problems, neurologic problems develop in one third, and one third exhibit severe neurologic deficits (coma, convulsions, blindness, and paralysis, probably associated with anoxia).
- occurs in three distinct stages:
  - Catarrhal stage:

    Mild upper respiratory tract infection with sneezing, slight cough, low fever, and runny nose (lasts 1-2 weeks)

  - Paroxysmal stage:

    Extends to the lower respiratory tract, with severe cough (5 -20 forced hacking coughs per 20 seconds); little time to breathe causes anoxia and vomiting; tissue damage predisposes the patient to secondary bacterial infections and pneumonia (lasts 1-6 weeks)

  - Convalescent stage:

    Less severe cough that may persist for several months

Control

1. **Therapy.**

Antibiotic treatment can only be expected to be effective during the catarrhal and early paroxysmal phases before the virulence factors are bound to the corresponding cell receptors. Macrolides are the agents of choice, Erythromycin.

2. **Epidemiology and prevention.**

Pertussis occurs worldwide. Humans are the only hosts. Sources of infection are infected persons during the catarrhal phase, who cough out the pathogens in droplets. There are no healthy carriers. The most important preventive measure is the active vaccination. Although a whole-cell vaccine is available, various a cellular vaccines are now preferred.

Vaccine:

Triple Vaccine (DPT)

1. Killed vaccine : with causing side effect
2. Acellular vaccine based on **FHa** and **Ptx** now available.